Department of Conservation
Division of Oil, Gas, and Geothermal Resources

October 15, 2015

Mr. Michael Montgomery
United States Environmental Protection Agency – Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Dear Mr. Montgomery:

On July 31, 2015, the Division of Oil, Gas, and Geothermal Resources (Division) and the State Water Resources Control Board (State Water Board) submitted findings from a review of Category 2 Underground Injection Control (UIC) wells. After discussions with your office, we are providing additional information regarding the analysis conducted by the State. For reference, Category 2 wells are those UIC enhanced oil recovery (EOR) wells that were permitted to inject into non-exempt aquifers. The State identified 5,625 wells that fit these criteria, and created two subgroups: (1) wells associated with a UIC project (2,021 wells) (Attachment 1), and (2) wells not associated with a UIC project (3,604 wells) (Attachment 2).

Risk-Based Approach

As detailed in our July 31, 2015 letter, the State has employed a risk-based approach to its review process to help assure early determination of potential risks to groundwater with a current beneficial use. Of the three EOR techniques– water flood, steam flood, and cyclic steam – the State has determined that water flood operations present the highest potential risk to groundwater since they involve injection of a high volume of water, relative to thermal operations. Given the use of a higher volume of water, there is a greater potential injectate could impact nearby groundwater resources used for beneficial uses. Following this logic, the State considers steam flood operations to pose a greater potential risk to groundwater than cyclic steam operations.

Screening Criteria

Accordingly, the State has employed different screening criteria, based on the type of operation at issue, to identify Category 2 wells that pose a potential risk to groundwater with a current beneficial use.

Water Flood

In contrast to thermal EOR operations, the quantities of water injected in water flood operations is relatively high. The Division's review of 2014 production data shows that the total volume of water injected in the State via water flood operations is more than twice the volume of water injected in all steaming operations (2014 Preliminary Report of California Oil and Gas Production Statistics, DOC-DOGGR, July 2015, page 3). Due to the higher quantities of water injected in water flood operations, there is a higher risk that fluids could migrate away from the area of injection. Accordingly, the state is using more conservative screening criteria to identify water supply wells that may be impacted by water flood operations. For water flood wells, the State is using the criteria outlined in footnote two of Enclosure D to its February 6, 2015 letter to the US EPA:

Activities potentially impacting water supply wells include injection wells that meet either of the following criteria: (1) the uppermost depth of the injection zone is less than 1,500 feet below ground surface (regardless of whether any existing supply wells are in the vicinity of the injection well), or (2) the injection depth is within 500 feet vertically and 1 mile horizontally of the screened portion of any existing water supply well.

Thermal Wells

Thermal injectors (cyclic steam and steam flood) inject steam into the oil-producing zone to lower oil viscosity and increase oil mobility such that it flows into production wells. In the case of cyclic steam wells, the injection well is also the producing well. Steam, by its nature, does not travel far from its injection point. Because of heat dissipation in the rock formation, steam injectors are located relatively close to production wells to optimize oil sweep. This distance is typically less than 150 feet for cyclic steam wells.

With close proximity to production wells, it is expected that the migration of steam outside of the production-injection pattern is negligible since the production-induced pressure drawdown keeps injected fluid within the pattern. A sample fluid analysis of feedstock water that is converted to steam is shown in Attachment 3. The total dissolved solids (TDS) value of the feedstock is commonly less than the formation TDS. The quality of the fluid used for steam, measured in TDS, after conversion to steam, is expected to be even better (lower TDS) since some of the TDS constituents are eliminated in the conversion process.

Steam Flood

For steam flood wells, the State is screening for water supply wells within one-quarter mile of the injection well, which represents the Division's determination of the lateral zone of endangering influence (ZEI) for these types of wells; in other words, the greatest lateral distance the injected steam is expected to travel from the point of injection.

Cyclic Steam

For cyclic steam wells, the State is screening for water supply wells within 300 lateral feet of the injection well, which represents two times the Division's determination of the lateral ZEI influence for these types of wells. Given the small ZEI for cyclic steam wells and the fact that these wells are located in oil fields that are typically at some distance from neighboring water users, the state has decided to incorporate a buffer zone (twice the ZEI) to screen in more wells to review for potential impacts.

Review of Water Flood Wells

The initial State review identified nineteen (19) water flood wells that were permitted to inject into non-exempt aquifers. Of those, nine (9) were subsequently identified by the Division as injecting into formations greater than 10,000 TDS, which do not require an aquifer exemption. The remaining ten (10) water flood wells were screened using the Enclosure D criteria described above. Based on this screening, the State has identified three (3) water flood wells.

The State Water Board, in collaboration with the appropriate Regional Water Quality Control Boards (Regional Boards), plans to issue orders to the operators of the three (3) wells at issue under Water Code section 13267 to gather more information on these injection wells and to take appropriate action to protect nearby water supplies if necessary. With regard to the water flood wells not subject

to informational orders at this time, the State may further analyze these wells later if they are within an aquifer for which an exemption is being considered.

Review of Thermal Wells

Our review identified that 5,475 of the 5,625 EOR wells are thermal injection wells. Of those, 4,780 are cyclic steam wells. Using the criteria described above, two (2) cyclic steam wells are located within 300 feet laterally (two times the ZEI) of identified water supply wells. Of the 695 steam flood wells under review, one (1) is within one-quarter mile laterally of water supply wells.

Based on the results of this review, the State Water Board, in collaboration with the appropriate Regional Boards, plans to issue orders to the operators of these three (3) thermal injection wells under Water Code section 13267 in order to gather more information on these wells. Upon reviewing the information provided by these operators, the State will take appropriate action to protect nearby water supplies, including, if necessary, issuing shut in orders to cease injection activities. In the future, the State may further analyze these injection wells if warranted, such as an aquifer exemption proposal.

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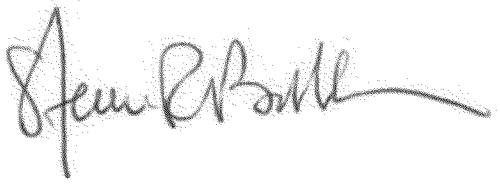
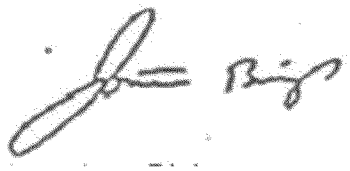
The State of California is very concerned about the protection of water that may be used for beneficial use, and is actively working with operators to collect additional information to identify any potential threats to protected water. Based on data collected by the operators pursuant to the planned 13267 orders, we will determine if there is a potential risk to groundwater with a current beneficial use. If we determine that there is a potential risk to protected water, we will take appropriate action to address these risks.

Sincerely,



Steve Bohlen
State Oil and Gas Supervisor
Division of Oil, Gas, and Geothermal Resources

Sincerely,



Jonathan Bishop
Chief Deputy Director
State Water Resources Control Board

Attachments

cc: Cliff Rechtschaffen, Senior Advisor, Governor's Office
John Laird, Secretary, California Natural Resources Agency
Matthew Rodriquez, Secretary, California Environmental Protection Agency
David Bunn, Director, California Department of Conservation